

## Rational Harvesting Policy and Sustainable Development of Community in Forest Regions

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**ABSTRACT** Forest ecosystem is one of the most important ecosystems in the world that human-beings rely on. Forest harvesting policy is one of the main criteria indicating how and how much the human beings open up and make use of forest. Whether the policy is reasonable or not has high relations with not only the increasing or decreasing of forest system, but also the development speed of human society. In this paper, the author analyzed the development of interaction between human society and forest ecosystem from ancient times to today. Then author stated that the rational harvesting policy should be the harvesting sequences of both harvesting density and harvesting time, which might result in the maximum comprehensive benefit, including economical profit, social benefit and ecological benefit, of forest to human society. At last, according to the analysis of interaction between human-beings and her environment, the prediction analysis for human society development in forest regions in the future was presented using Entropy Growing Analysis.

**Keywords:** Forest harvesting; Rational harvesting policy; Sustainable development; Forest regions.

### INTRODUCTION

Many forest enterprises in Heilongjiang Forest Region, China are facing with serious problems of finance shortage and resource rapidly decreasing today. High demand of timber and other forest products in the past resulted in over harvesting and improper harvesting. This has been obviously making forest resources available worse and worse. Thus the adverse feedback circulation with poor resource and less profit occurred in 1980's. Shortage of development funding, is one of the problems, which really makes the managers of these enterprises headache very much. On the other hand, the poor resources are not able to meet the highly increasing demands of forest products for the construction in China.

### WHAT IS THE RATIONAL FOREST HARVESTING POLICY

Forest harvesting is a kind of production activities that human-beings open up and make use of forests. The definition of rational forest harvesting policy should be discussed from view point of development of human society and from development of forest individually.

**Development of Human Society and Forest Harvesting** The interaction between human society and forest ecosystem occurred quite long time ago when human-beings formed in some extent the "society". The density of action to forest depended on the bearing capacity of forest ecosystem and the acting ability of human society in different times

In ancient times, about 5000-- 7000 years ago,

human-beings got quite friendly and amicably along with forest because knowing little about forest. Of course, no formal harvesting activities existed during that period. Most of the production activities were hunting and fishing.

With growing of human-beings population, the food demand of human-beings increased gradually. Therefore, the rate of energy input into human society was rather limited under the given production ways, such as hunting and fishing. Food crisis occurred at last in the late of fishing-time and it significantly hindered the growing and developing of human society. Agriculture was found during the horrible struggle with food crisis. The food produced in 0.5 acre land in farming way is more than that of produced in 800 acres in hunting way. Burning down forest and then farming was the prevailing production way in thousands of years. Sufficient food and permanent settlement resulted in the highly growing of the population. And then the highly growing population offered high food and living pressure on her environment, including the farming land and forest. A group of ancient people had to transferr to another place after farming a stretch of land for some time due to soil fertilizing decay and other environment support decreasing. So another tract of forest was burnt down for farming. Because of longer growing rotation of forest, a large tract of forest might be finally varnishing after the repeatedly burning and farming.

During this period, the ancient people thought forest resources were so greatly vast that they could not be used up forever. The "rational harvesting policy" they had was the more forest harvested, the better benefit

they would get.

After thousands of years, large tract of green forest in the world were replaced by deserts and wasteland due to excessive harvesting, burning and farming. For example, ancient Europeans nearly ate the forest among Alps Mountain up to 16th century. And ancient Chinese people cut the forest along the Yellow River in hundreds of years ago, so the Yellow Plateau and the "Suspending River" left. According to the literature<sup>[1]</sup>, the forest area in the world decreased acceleratedly (Table 1) and now still 30 thousand hectares of forest for the whole world is being changed to other ecosystem each day.

Table 1. Decreasing of forest in the world

Time	3300 B.C.	1860 A.D.	1975 A.D.	1986 A.D.
Forest Area (billion hectares)	7.6	5.5	2.9	2.3

On the other hand, human-beings population explored with a highly accelerated trend because of sufficient food and better living settlement supplied by forest. It took more than 30,000 years for the Earth producing the first one billion people, but less than 100 years producing the third one billion, and less than 20 years producing the fifth one billion.

It is explicit from the discussion above that the rational forest harvesting policy from the human society side is that the short-term supplies from forest should meet the needs of her developing without environmental limitations. But the greatly decreasing of forest has caused much more serious environment problem for human-beings, such as acid rain, flood, air pollution, water pollution and climate warming etc.. These significantly restricted the development of human-beings. It seems there are many limitations of resources to support the human-beings, including the forest resources.

**Development of Forest Ecosystem and Forest Harvesting** Forest ecosystem has its own developing laws and its own characteristics. In terms of the results of forest ecology research, the total biomass of a forest ecosystem follows the growing trend as shown in Fig. 1. When input and output of energy to and from forest ecosystem nearly keep balance, the total biomass of the ecosystem hardly increases, even decreases. At this time, it is necessary to break the balance by a interfere outside of the ecosystem, such as harvesting. But if the interfere intensity were over the critical limitation value of the forest ecosystem, the forest ecosystem would successively change from forest to another lower ecosystem, such as jungle or grass land, or even wasteland without any green. For instance, the tropical forest would has successing success in the following way if being impacted too much:  
Tropical forest ==> tropical jungle ==> tropical grass-

land ==> desert, or tropical forest ( quite steep terrain ) ==> wasteland.

It is reasonable to carry out harvesting when the forest system grow up to mature stage, but the intensity of harvesting must be under the maximum limitation value of the forest ecosystem.

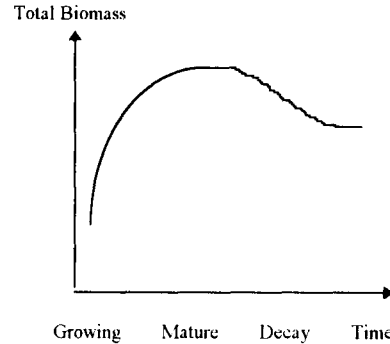


Fig. 1. Total biomass changing ecosystem

Quite often people definite the rational forest harvesting policy on the basis that human-beings is centre of the world and everything in the world must be unconditionally controlled by herself. Up to now, human-beings have understood that forest is one of her most important friends. People now try to "negotiate with forest" to make the so called "rational forest harvesting policy" which represents the integration of short-term (e.g. economical benefit) and long-term benefit (e.g. ecological benefit) provided by forest to human society.

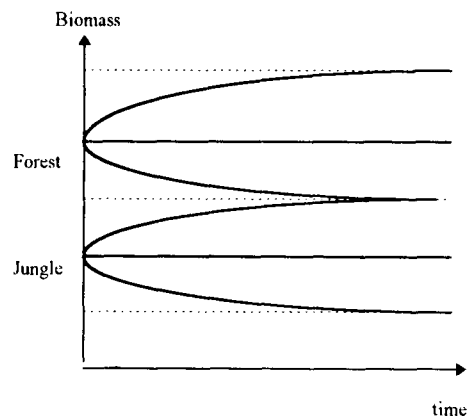


Fig. 2. Succession of forest ecosystem

## SYSTEM ANALYSIS FOR THE DEVELOPMENT OF HUMAN SOCIETY IN FOREST REGIONS

If the forest regions were considered as a system, entropy of the system should consist of two parts: positive entropy which makes the system chaotic and negative entropy which makes the system active.

$$S(t) = IS(t) + ES(t) \quad (1)$$

where:  $S(t)$  -- total system entropy at time  $t$ ;

$IS(t)$  -- positive entropy of system at time  $t$ ;

$ES(t)$  -- negative entropy of system at time  $t$ .

Derivative on both sides:

$$dS(t) = dIS(t) + dES(t) \quad (2)$$

According to the results obtained from literature [1], the going trends of  $S(t)$ ,  $IS(t)$ ,  $ES(t)$ ,  $dS(t)$ ,  $dIS(t)$ ,  $dES(t)$  for a given region were shown as Fig. 3.

(1) If  $S(t) > 0$ , e.g.  $IS(t) + ES(t) > 0$ , the given system is just under difficult or even crisis condition.

(2) If  $S(t) < 0$ , e.g.  $IS(t) + ES(t) < 0$ , the given system is just under progressing.

(3) If  $dS(t) > 0$ , the given system is running with a adverse acceleration trend.

(4) If  $dS(t) < 0$ , the given system is running with a positive acceleration trend.

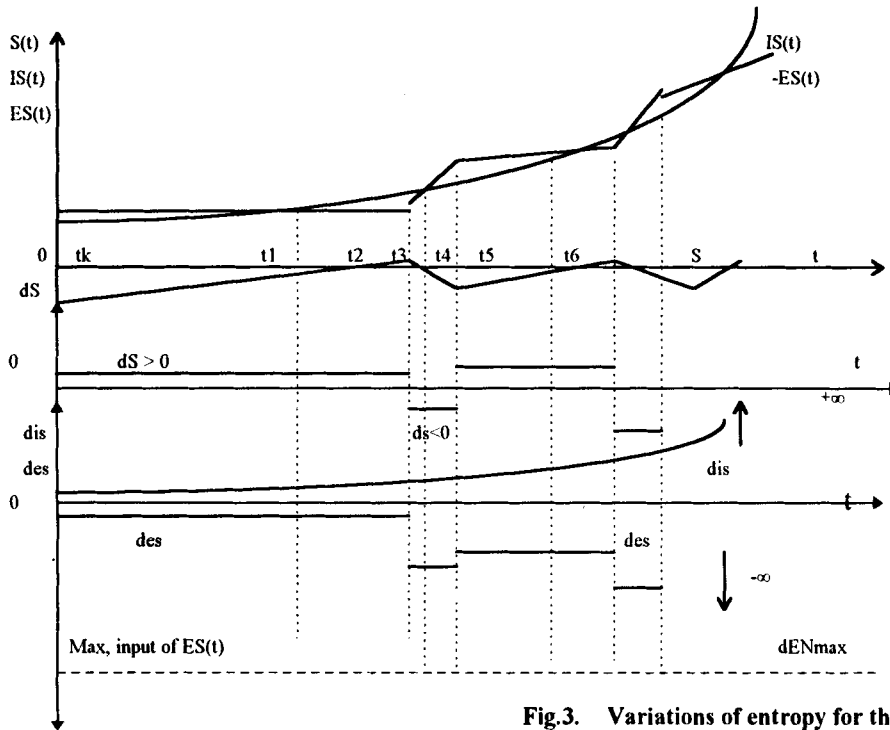


Fig.3. Variations of entropy for the system

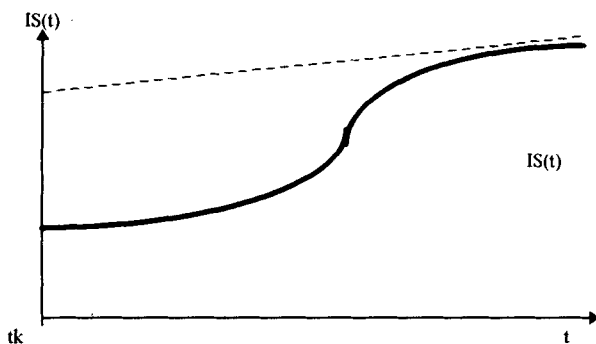


Fig. 4. Ideal development of  $IS(t)$  for human-society

The given system is under

(1) more and more difficult conditions during  $(t_1, t_2)$  period;

(2) difficult conditions with decreasing trend during  $(t_2, t_3)$  period;

(3) acceleratively progressing during  $(t_3, t_4)$  period;

(4) progressing but gradually slowing down during  $(t_4, t_5)$  period.

Most of business development may follow the trend mentioned above. The differences for the individuals

might be the time period length for different stage. Now many of forest enterprises in Heilongjiang Forest Region are just under  $(t_1, t_2)$  period, more and more difficult period. The possible perspective ways for them are:

(1) successfully passing through the crisis point  $t_2$  and going to next stage with more energy input;

(2) still struggling with the crisis;

(3) completely failed.

## SUSTAINABLE DEVELOPMENT OF COMMUNITY IN FOREST REGIONS

Sustainable development of community in forest regions means that the energy demand for local people living and local society development should be equal or less than energy input into society from both her local environment and that outside of the region for a given period. It is clear that at least during that period the total entropy of the region should be:  $S(t) < 0$ , e.g.  $IS(t) < ES(t)$ . This is the premise for the forest region to realize and keep the sustainable development. Another premise is  $dS(t) < 0$ , e.g.  $-dES(t) > dIS(t)$  or  $|dES(t)| > |dIS(t)|$ . The system of forest region would be under accelera-

tively progressing if meeting these two premises.

In order to control or reduce  $IS(t)$  growing, the following steps might be the most positive measures for forest enterprises based on the system analysis above. The ideal going trend of  $IS(t)$  should be in the way of hyperbola curve ( Fig. 4).

(1) strictly control the people population in forest region according the support capacity of this piece of land concerning the annual biomass production;

(2) completely reform the structure of the society in the region to reduce nonproduction part as more as possible;

(3) scientifically make and revise laws and regulations for the region running.

On the other hand, more suggestions should be considered in order to increase  $ES(t)$ :

(1) to increase the quantity and quality of forest, for instance, enhancing plantation greatly and reducing harvesting properly;

(2) to promote the values of forest products through proper further processing and marketing system, e.g, the properly promoting the price of forest products;

(3) to establish the new production systems like agriculture production or tourist production to increase the ratio of energy input;

(4) to reasonably produce assortment products as more as possible within the environmental limitations.

### SUMMARY

Forest harvesting is an reasonable production activ-

ity with regarding to the social and environmental aspects. The problems or even crisis for forest regional development, from which people in Heilongjiang Forest Region are suffering, are not only caused by forest harvesting, but also by population exploration and improper society structures and organizations. Sustainable development of society in a region or a country is more dynamic rather than steady developing progress. It is possible to realize and keep the sustainable development for an region during a given period, but not forever.

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